A RECENT CONTRIBUTION OF THE FEDERAL GOVERNMENT TO PREVENTIVE MEDICINE AND HEALTH CONSERVATION.

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The United States Government, through the Bureau of Labor Statistics of the newly created Federal Department of Labor, aims to discover the true death hazard of wage earners, by age groups, sex and race, within the several occupations, and hopes to disseminate that knowledge widely among the people, together with information concerning other phenomena and accompanying circumstances of living that plausibly may explain interruption of life within age periods normally, of greatest economic efficiency. Such an educative campaign as that of which this Vol. XIV of the 19 volume U. S. Senate Document No 645, 61st Congress is the first concrete illustration, and cotton manufacturing, the industry initially thus studied, would seem to form no unimportant part, therefore, in the modern crusade to conserve health, and to be an essential prerequisite to the success of Preventive Medicine.

Especially noteworthy, perhaps, among incidental results accomplished through this inquiry are the following:

1. Recognition and thorough demonstration of the inherent and practical superiority of the death rate or induction method which (except for three descriptive pages inserted chiefly as an illustration of the usual or inspection method), is employed exclusively throughout this work; is the

II. Recognition that practically for any study into anti-longevity causes, age group 15 to 44 alone is amply representative of an industry's health characteristics, and overwhelmingly so as regards such industries as largely employ females. For since it is shown that regularly only about one third of the aggregate deaths of individuals aged 10 years and over (and hence potentially of working age), fall within age group 15 to 44, a practical application of this sufficiency of age group 15 to 44 for any ordinary investigation into conditions affecting longevity, obviously may save in future similar studies, two thirds of the labor which the present work required.

III. Recognition of the principle that fundamentally the desirableness of any of the phenomena or accompaniments of living each is measura-

able, and, therefore, interrelatively comparable, only through time units, *i.e.*, only through its anti-longevity effect;

IV. Recognition of the principle that however unequally noxiousness may have been apportioned among the various factors or forces contributory to death, still the aggregate forces which ended, for example after 30 years, the life of any specified individual, must always equal the aggregate forces which ended at the same age of 30 years the life of any and every other individual. Thence through simple algebraic processes of elimination of common factors, etc., suggestive and instructive equations ultimately may be developed, especially when the contributory factors in many thousand lives ended similarly at the age of 30, shall be available likewise for comparison.

A small table, on page 153, of the volume, illustrates how practical and plausible are the tentative inductions that logically may be drawn even now through a modified application of these just-mentioned principles.

Object.

The primary object of this study specifically, however, was to secure essentially accurate age group death rates for the great cotton manufacturing industry. In pursuit of this primary object the investigation disclosed the fact that in the country's largest cotton manufacturing city not even one half of the females who had died two years or less after quitting cotton-mill work were recorded upon the official death certificate as having been cotton operatives.

At the present time, therefore, even in the registration states which are reputed to gather their vital statistics most carefully, the official death records fail to indicate even approximately how many woman cotton operatives die each year, although cotton manufacturing is the foremost industry of the chief of these states and half the workers in it are women. That knowledge of the true mortality statistics of an occupation is an absolute prerequisite to an intelligent formulation of adequate remedial measures seems obvious.

A second and very practical purpose was to point out the true underlying or basic factors or agencies to which the debility or impaired health, which must usually precede death, may reasonably be ascribed.

From the practical standpoint, interest would seem to attach far less to the officially designated causes of death—the so-called diseases—than to the debilitating factors of which the disease may be only the final manifestation. For early recognition of such debilitating and disease-producing factors may render it possible either to remove them or make them harmless by increasing the physical resistance of the prospective victim, who, knowing his danger, may take suitable means to avoid it. Prophylactic or disease-preventing efforts are infinitely more useful than cura-

tive ones. But for the prevention of debility, disease, and premature death, knowledge of their basic causes is obviously an essential prerequisite.

Basis of Inquiry.

The study is based upon transcripts of the official death certificates, furnished in Massachusetts by the Secretary of State, and elsewhere by secretaries of the respective State Boards of Health.

Excepting solely as regards "occupation" and as respects such decedents as had died immediately after parturition, the original data of the official certificate invariably have been used in this initial analysis of anti-longevity causes without any change whatever.

And this, too, despite the fact that in a number of cases in which the physician's certificate gave some such equivocal cause of death, as bronchitis or hemorrhage, or some terminal condition, such as broncho-pneumonia or heart failure or debility, the history of the case when studied showed almost beyond question that tuberculosis had been the real cause.

Method of Securing Data.

To attain these two objects—the correct mortality by age groups in the cotton manufacturing industry and a knowledge of the underlying debilitating factors which might explain this mortality—a personal inquiry was undertaken concerning each individual, aged 10 years or over, who within a three-year period had died from specified diseases or causes within specified cotton manufacturing cities. This inquiry was made at the late home of the decedent and nearly always from a relative, who furnished information also as to the decedent's family, his habits, occupational and conjugal experiences, exposure to communicable disease and other personal facts of possible significance in explanation of his death. Moreover, the investigator personally inspected the premises and made note of certain hygienic conditions which might have been numbered among the debilitating factors which led up to the death.

Reliability of Information Secured.

Owing to the fact that tuberculous operatives showed a tendency to return to their early homes when they were no longer able to work, it is probable that for all the cities studied the number of operative decedents is slightly understated. It is quite certain that there is no overstatement of the number, because no decedent has been classed as an operative unless a definite statement to this effect was made by an informant whose name is on record. The statement on which the occupation classification is based included not only the fact that the decedent had been a cotton operative, but also the name of the mill in which he had been employed, usually, also, the specific occupation at which he had worked, and always

the fact that he had been employed at such mill work within a specified period, not exceeding two years, before his death.

It is obvious that evidence so specific and detailed would not probably be manufactured, especially as the informant had no inducement to misrepresent the facts in either direction. During the course of the investigation an incidental proof was obtained of the general accuracy of the information gained. The inquiry was begun in Fall River. Five months after its data had been secured a change in the scope of the investigation made it necessary to record certain additional data concerning female decedents, which could only be obtained by revisiting the earlier informants. In this reinvestigation, several hundred persons were questioned a second time on points on which they had first given information five months earlier, yet in only two cases was their testimony found to differ from the original statement in any important particular.

"Operative" Defined.

The term "cotton operatives" is used to mean only those persons whose work had been such as to expose them many hours daily to the processes or hygienic conditions peculiar to a mill that manufactures cotton wadding, yarn, thread or cloth. The term has been still further restricted by limiting it to those who were either working in a cotton mill up to the time of death, or who had left it not more than two years before death. This arbitrary limit was fixed upon after consultation with eminent medical men as being probably well within the period during which the effects of mill influences, even if latent while the decedent was in the mill, might yet be considered beyond question as having borne a causative relation to his death. In the course of this study many facts were elicited showing resemblances, sometimes almost to identity, between the class just outside the two-year limit and the operative class. It was felt that this fact gave a strong indication that the two-year old limit erred, if at all, on the side of conservatism, and that possibly a limit of three or even four years, or the inclusion of nearly lifelong cotton-mill workers retired through age, would have been fairer.

Comparative Study of Selected Groups and Classes.

"The age period, 15 to 44 years, was selected for special intensive study because it represents a period of full industrial activity during which the death rate would normally be low.

"A second reason for choosing this age period for special study lies in the fact that more than one-half the entire population is found within its limits, so that it presents a wider field for study than a more limited age group could do. Moreover, for a study of causes of death among cotton operatives, this group presents unique advantages, since more than four fifths (85 per cent.) of the entire operative population is included within

it. Also within its limits are found three fourths (76 per cent.) of the entire number of tuberculous deaths of individuals aged 10 years and over, nearly three fourths (73 per cent.) of the whole operative mortality from all causes; and fully nine tenths (91 per cent.) of the entire operative deaths from tuberculosis."

Evidently any specified cause or disease is important just in proportion as it is active among the country's producers and its reproducers—its workers and its child bearers. And since the child bearers are almost wholly, and the workers very largely, found within the age group 15 to 44, the different causes of death challenge attention and call for remedial action in proportion to the share of their victims they draw from this group. Hence the question of foremost importance to be answered concerning a specified disease or cause of death is not: "How many deaths are ascribable to it? " but, rather, "Are most of its deaths within age limits that embrace the bulk of the productive population?"

So, finally, tuberculosis was selected for intensive study because it was found to be the most prevalent ultimate or immediate cause of death within the age period 15 to 44, which comprised one half the total population and four fifths of the operative population of the cities selected for study.

Method of Estimating Significance of Contributory Causes of Death.

There are certain circumstances or experiences, common but not inevitable accompaniments of living, which may be active factors in the causation of both disease and death. Such, for instance, are (1) bad heredity; (2) ignorance; (3) bad air, whether germ laden, dusty, humid, or chemically impure; (4) bad food, that is, ill chosen, ill cooked, or ill chewed; (5) bad or alcoholic drink; (6) bad personal, sexual, or apartment hygiene; (7) long labor and short sleep; (8) occupational stress (hurry and worry); (9) scant income, whether through thriftlessness, misfortune, or low wages; (10) accompaniments of the conjugal condition, such as childbirth and dependents; (11) overwork or non-resiliency from fatigue. These or some of these conditions might be encountered in the life history of any decedent, and it has been assumed tentatively that the significance of any such condition as a causative factor of death is established by the frequency with which it was found to have occurred as an antecedent of the deaths studied.

For example, the following study shows that in Fall River 29 per cent. of the decedent female cotton operatives had had tuberculous relatives, while only 21 per cent. of the decedent male operatives had had similarly affected relatives. In accordance with the above principle it has, therefore, been tentatively assumed that tuberculous kindred have more influence as a causative factor of deaths among female than among male operatives.

Again, the economic importance of any factor or group of factors is

measured fundamentally by its longevity effect; *i.e.*, its effect on the duration of life. In this study it has been tentatively assumed that this effect is shown by the rare occurrence of a given factor in the life history of young decedents, or conversely by its frequent occurrence in the life history of those who attained a high average age before death.

For instance, it was found that in one of the cities, during the three years covered by this study, four fifths (79 per cent.) of the total number of deaths from tuberculosis among the female population aged 10 years or over occurred in the age period 15 to 44, while of the deaths in the same age and sex group from pneumonia and cancer less than a third of the first and one quarter of the second occurred in the age period 15 to 44.

In other words, tuberculosis had a far more marked anti-longevity effect in this group than either of the other diseases. But this period is that of the greatest industrial importance. It is evident, then, that so far as this section of the population is concerned, tuberculosis, which finds its greatest number of victims in the period of chief industrial activity, is economically far more important than pneumonia and cancer, which find their victims principally among those whose industrial effectiveness is either waning or practically at an end.

Basically each life experience is bad in proportion to the extent that it shortens life. It is only, therefore, by a comparison of the ages at death of individuals whose lives were characterized by specified experiences that the relative effectiveness of these experiences in ending life can be determined.

This method of reaching conclusions as to the physical condition of a specified class of individuals by a comparison of accurate death rates has been so seldom mused and differs so radically from the customary method that the main points of variance between the two modes of investigation need some consideration.

Advantages of the Death Rate Over the Inspection Method.

First of all, these two methods differ widely in the sharpness with which their basic terms may be defined. For the term death has a precise significance and is unqualifiable; whereas the term debility, ill health, or disease is inexact and qualifiable. Moreover, the unit of the one measure, death, is a demonstrable fact, while the unit of the other, ill health, may not be susceptible of demonstration. The one is absolute, the other only relative. And finally death is fixed and unchangeable, whereas ill health is variable.

Secondly, the death-rate method has a great advantage over the inspection method in the possibility it offers of isolating a given life experience—as, for example, cotton-mill working or tuberculous infection, from other life experiences or circumstances, and for determining its relative probable

power for harm, or anti-longevity effect. For this purpose the unit of the death-rate method—an individual dead—is worth immensely more than is the unit of the inspection method—an individual debilitated, ill, or diseased.

For when it is said that a given number of individuals at a certain age are in ill health or diseased, it is impossible to say how much injury any one of them has suffered or will suffer from the ill health or disease by which he is affected. His physical condition is the result of a number of factors acting in combination. It might conceivably be possible to learn every one of these factors, but as there is no way of measuring definitely the amount of harm they have accomplished in combination, there is evidently no way of determining the amount of harm for which each is responsible. Together they have brought about a general condition known as ill health, or perhaps some specific condition such as tuberculosis or typhoid fever, but the inspection method affords no way of learning what either the general or specific condition means in years of life sacrificed or industrial efficiency lost.

But when it is stated that a given number of individuals of a designated age have died, it is evident that each one of them has suffered the greatest total physical injury to which any individual of that age is susceptible. The factors which have produced death at the specified age undoubtedly differ widely from case to case in number, in identity, and in individual harmfulness, but in every case their combined effect has been the same—death within a specified age period. Knowing, therefore, their combined effect, it becomes possible to determine with some degree of accuracy the relative degree of harmfulness of each factor.

Another very marked advantage of the death rate method as used in this study is the opportunity it offers for comparison between occupational groups, or between those in one occupational group and the general population. Thus, in the present case, concurrently with the investigation into the underlying causes of death among cotton operatives, a corresponding investigation was conducted into causes of death among the non-operative decedents within the same age period. To show the value of such comparative statistics in investigating health and longevity problems, let it be supposed that the data so collected show two groups of married female decedents of essentially equal physical and mental hereditary endowments and of essentially similar life experiences, except that those of one group were engaged in cotton-mill work for the fifteen years next but two preceding death, while those of the second group were engaged in housework at home for the same period. Let it be further supposed that each of these decedents had been exposed to tuberculous infection through a consumptive member of her family, and that all died of tuberculosis,

the cotton-working group at the average age of 30, the home-staying group at the average age of 40 years. These contrasting occupational groups might then be said to constitute a vital experiment—infection—performed under conditions, *i.e.*, vital experiences, seeming to differ in but one material circumstance, the conditions of work. The difference of ten years in length of life might logically, therefore, be attributed to that one circumstance.

An added advantage of the death-rate method is that it has to do the more with malign influences. For as psycologists, alienists and criminalogists through study of the grossly abnormal in child and adult are discovering the basic laws of mind; and as anatomists and pathologists through dissection and microscopic examination of the cadaver are discovering the basic laws of surgery and remedial medicine; so analogously, students of prophylactic or preventive medicine should find analysis of life experiences and circumstances of the dead, rather than of the sick, the more prolific in conclusive results or disclosures concerning the basic laws of health.

The possibilities of logical inductions (or colloquially, of common sense reasoning) surely to follow from use of the unit of the death rate method in securing the isolation of a suspected anti-longevity factor and in the subsequent rough measuring of that factor's destructiveness to life, as well also as in comparing its own malignity with that of other anti-longevity forces, have been demonstrated in the following small "key-note" table on page 862.

A comparison of the average age at death of the three classes included in this table shows that among female decedents in Fall River who had been mothers, tuberculous operatives died at the earliest age. These also had borne the smallest number of children per decedent mother, and showed the largest percentage of deaths among these children.

Next in average age at death came the non-tuberculous operatives. These showed a moderate degree of child bearing and a moderate mortality among the children produced.

Finally came the tuberculous non-operatives. These showed a moderate degree of child bearing and the smallest percentage of deaths among the children.

Inductions.

The fact that it averaged eleven years less time for the factors in Class I, than for those in Class III, to produce a bodily state fatally vulnerable to tuberculosis, points to cotton-mill employment rather than to prolificacy as having been by far the more important causative factor in the death of married Fall River females in 1905 to 1907.

Likewise, Classes II and III would seem to indicate that cotton-mill employment unhandicapped with tuberculosis was basically a weightier factor in fatally terminating motherhood than was absence of operative work even complicated with tuberculosis.

Moreover, the fact that it required eight years less time for the factors in Class I than for those in Class II to effect a fatal result emphasizes how great a life-shortening factor tuberculosis is and what social and economic loss it occasions.

However few the children, therefore, motherhood conjoined to cotton-mill work in Fall River constituted a combination of duties that was prejudicial to child life; and conversely for Fall River female decedent operatives of 1905 and 1907, any extra work outside the mill including the

COMPARATIVE FREQUENCY OF INCIDENCE OF DESIGNATED FACTORS AMONG SPECIFIED CLASSES OF FEMALE MARRIED DECEDENTS IN FALL RIVER DURING 1905 TO 1907, TOGETHER WITH THE RELATIVE LONGEVITY OF SAID CLASSES.

Age group 10 years and over.	Specified debilitating factors.					Casualty and infection.	Average longevity effect.
	Work.	Average prolificacy.	Average percentage of children dead.	Miscellaneous factors.	Resultant effect.		
Class I.—Tuberculous operatives (55).	Exclusively industrial.	Minimum.	Maximum.	(?)	Profound debility.	Tuberculous.	Death very early (age 30); brief illness.
Class II.—Aggregate nontuberculous operatives (118).	do	Next to minimum.	Next to minimum.	(?)	do	Minimal	Death less early (age 38); illness briefest.
Class III.—Aggregate tuberculous nonoperatives (66).	Minimally industrial.	Moderate.	Minimum.	(?)	Moderate debility.	Tuberculous.	Death least early (age 41); illness longest.

care of children, however few, constituted a seemingly debilitating influence that in the average case, even in the absence of tuberculous infection, was inimical to maternal longevity.

Summary of Specific Results.

These are some of the salient points brought out in the study, as disclosed by the report.

I. The effect of cotton operative work upon health, as reflected in the death rate, differs widely between the sexes. For the thirty-year age period

from 15 to 44, in which the great majority of the operatives are found, the death rates of males and females in the general population are almost identical, the male rate being 6.19 and the female rate 6.18. A comparison of the death rates of male and female non-operatives shows the rate for males to be 22 per cent. in excess of that for females (male rate, 6.48; female rate, 5.31). When, however, the comparison is confined to the death rates of operatives the female rate shows an excess of 33 per cent. over the male (male rate, 5.74; female rate, 7.63) despite the younger ages of the female operatives.

II. For the population aged 15 to 44 as a whole, and for every 5 year age group subdivision except two, the situation as to racial mortality may be thus summarized: Of all the races and peoples, the Americans exhibit considerably the greatest, and the Irish the least, physical resistance to fatal influences, the former having been about one-third less and the latter about two-thirds more liable to die from "all causes" than the general population: the English were about one-quarter less liable to death than were the individuals of all races on the average; and finally the French Canadians exhibit slightly less and the "Other races" slightly more than combative resistance to death than is shown by the average of individuals of all races.

III. In the age groups within which operatives and non-operatives are fairly comparable, female operatives have a decidedly higher death rate than non-operatives. This is most marked in respect to tuberculosis, the death rate of female operatives from this cause being in general more than twice that of non-operatives, and in some of the race and age groups running up to many times as high. Thus, in the age groups 15 to 24 years, 25 to 34 years and 35 to 44 years, the death rates from tuberculosis per 1,000 were, respectively, two and one-fourth times, two and one-half times, and five times, those among women of the same age groups outside the cotton industry. Furthermore, as respects males of the aggregate non-Irish races, comprising about six sevenths of the total male population aged 15 to 44, male cotton operatives were slightly, though constantly, more than were male non-operatives liable to death from "all causes," and they far exceeded non-operatives in death hazard from tuberculosis (in Fall River, three years, and three cities one year, excess 74 per cent., 81 per cent.).

IV. Of great importance is the demonstration that at no age were individuals embraced within this study even moderately free from the liability of death from tuberculosis. For even among the obviously largely non-industrial senile population aged 65 years and over, its prevalence was fully one-half (1.61) what it was in that age group, 30 to 34, within which its ravages were greatest (3.19), and in which industrial activity is commonly supposed to be at or near its zenith.

In short, it was found that even numerically as inadequately reported officially as was characteristic of the years 1905–6–7, tuberculosis was yet the certified cause in age group 15 to 44 of one out of every two operative deaths approximately, and one out of every four deaths of non-operatives of both sexes and all races (per cent. tuberculous in Fall River 1 and 3 years, three cities one year—operatives 46, 44, 45—non-operatives 32, 37, 29).

The showing that intemperance in the use of alcoholic beverages had been a characteristic of those classes of males especially that had had the highest death rate from tuberculosis—viz., of the male non-operative Irish, and of the male operative Irish and non-Irish, and most striking of all, of the employees in the liquor trade—brings together coincidences that logically suggest the induction that habitual over-indulgence in alcoholic beverages is a debilitating factor of great weight in the causation of deaths of males from tuberculosis.

Stress—hurry and worry of work without rest intervals sufficient to assure normal resiliency after fatigue (that is, overwork in industrial establishments)—is with the possible exception of infection, the most important etiological factor noted in deaths of women from tuberculosis.

An examination of other factors which might effect the death rate, especially from tuberculosis, such as native or foreign birth, tuberculous kindred or intimates, overcrowding, sanitary condition of homes, etc., fails to show any such massing of unfortunate conditions among the female operatives as would explain their unvarying higher death rate.

Hence it seems impossible to escape the conclusion that operative work is prejudicial to the health of females, that the combination of operative work with matrimony is especially harmful, and that, while the general hazard of the female operative is greater than that of the non-operative, she is in most danger from tuberculosis.

Whether the harmful effects of operative work are greater than those of other industrial employments, and whether they inhere in cotton textile work as a whole or are due to certain occupations carried on within the mills, are questions for further investigations to answer, and the U. S. Bureau of Labor Statistics is engaged now in one such study. This inquiry, however, has established the fact of the high mortality among female cotton operatives and of their special susceptibility to tuberculosis.

In considering the real significance of these conclusions, weight must be given to the character of the death records on which they are based. This study has clearly established that such records, as at present made out. can not safely be used as the basis of mortality studies without investigation of their accuracy.

Registration Errors.

Very incomplete in every city investigated was found to have been official registration as to the occupation upon death certificates. More than one half (51 per cent.) of the female, and over one quarter (28 per cent.) of the male cotton operative decedents, of Fall River during three years, the inquiry disclosed, had been omitted from official certification as having been cotton-mill workers.

The study furthermore discloses that an astoundingly large percentage of those whose deaths were found to have been due to childbirth either primarily or secondarily, had been officially so recorded as to give no intimation that parturition had been a factor in causing death.

And finally a like disingenuousness or design was found evidenced in regard to erroneous registration of tuberculosis under meaningless or grossly misleading designations which gave no hint that tuberculosis had been a factor in the case.

But, however successfully this pioneer work of the Government has accomplished its avowed purpose, "to gain full information upon such points in the occupational and personal history of every decedent operative as might bear upon his length of life, the immediate cause of his death, and any contributory causes thereof;" and however valuable undoubtedly the specific results of the investigation may be, even though at present they may not all be comparable equitably with the uncorrected death data of industries other than cotton manufacturing, still in the author's opinion they all, nevertheless, in importance and real utility are but secondary, as compared with the *system* this study has developed as a method most likely to bring out basic *incontrovertible facts* regarding health conditions within any specified industry or community, to *identify anti-longevity* causes therein; and to *apportion and measure*, at least roughly, the harmfulness rightly ascribable to each such life-shortening force.

Discussion.

Vice-President W. T. Sedgwick: The book which is now passing around the room is Doctor Perry's report, and as it was based very largely upon personal investigations of conditions in Massachusetts it seemed proper that we who have so much interest in Massachusetts industries and Massachusetts health should take cognizance of it. It is quite impossible to follow everything from his verbal statement, but copies of the report may be got and studied at leisure. You have heard his main results as he stated them toward the end, one of them being the excessive mortality of women operatives—raising the question whether, after all, this industrial life of ours which puts woman in the mills under unwomanly conditions, as some of us regard them, is beneficial. Racial considerations, too, are important. The more newly arrived races seem the more susceptible to this particular disease, which is perhaps to be expected; but we may hope that, as time goes on, selection and acclimatization may strengthen all races coming to our shores, so that they can endure the somewhat untoward conditions which seem to prevail, perhaps necessarily, in our modern industrial